



**AMENDMENTS**  
**IN THE SPECIFICATION**

Please enter the following amendments:

1. Please amend paragraph 5 on page 4, lines 16 through 17, as follows:

R1 It is yet another object to provide an electromechanical locking system ~~enabling~~ able to accommodate a hierarchy of access security requirements.

2. Please amend paragraph 2 on page 7, lines 5 through 6, as follows:

R2 Figure 3 is an enlarged cross-sectional detail view showing the structure of a first embodiment of a lock constructed according the to the principles of the present invention;

3. Please amend the first paragraph on page 11, lines 3 through 20 as follows:

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R3 Plug 101 also contains sidebar 101g tapered into an acute (frequently blunted), axially extending bearing edge 101h partially recessed into a slot 102a formed axially along the exterior circumferential surface of cylinder 102. Sidebar 101g is typically biased radially outwardly by one or more springs 101k so that the leading axially extending edge 101h of sidebar 101g protrudes into a beveled slot 102a of a cylinder 102 encasing plug 101 after the complete plug 101 has been installed into cylinder 102. Pins 101b are cut in this particular embodiment with a groove 101d.

R3

When the blade of a mechanical key that has been bitted to correctly displace pins 101b radially outwardly from keyway 101a within their corresponding chambers 82 is inserted with the cuts of the land of the key precisely matching the coding (axial separation between the upper and lower portions of pins 101b) of pins 101b, then slots 101d will align with the legs, or pegs, 101m of the sidebar ~~102g~~ 101g. When rotational torque is manually applied to the key by the user, the beveled edges of slot 102a enables sidebar 101g to move radially inwardly and away from groove 102a against the bias of springs 101k slightly, but enough to allow plug 101 to rotate within cylinder 102, thus concomitantly rotating tailpiece 101q which, in turn, rotates a movable cam 103 or other member engaged by tailpiece 101q. In other applications, cam 103 may be connected to and, upon rotation of plug 101 and its tailpiece 101q, draw a bolt and thereby permit access to a secured item or into a secured area. Other embodiments allow a tailpiece 101q with a particular shape to drive a clutch, cam or linkage.

4. Please amend the paragraph that bridges pages 11 and 12, lines 21 through 14, as follows:

R4

The user may then rotate the key until plug 101 is aligned with a key extraction point where alignment between chambers 82 and the corresponding tumbler pins 101b ~~allow~~ allows the bias of springs 101k to force sidebar 101g radially outwardly until beveled edge 101h mates with slot 102a, and thus permits withdrawal of key 200 from keyway 101a. A cylinder lock of this type may have two or more grooves, or slots 102a spaced arcuately apart to provide several arcuately separate points

R4 at which a key may be extracted from plug 101. When pins 101b are engaged in the properly manufactured corresponding cuts in the blade of the key and each of pins 101b is correspondingly radially displaced outwardly within its chamber, and legs, or pegs, 101m of sidebar 101g engage corresponding circular grooves 101d formed in some, or all, of pins 101b as those pins 101b are forced radially outward by the bits of the key, the key may manually rotate plug 101 within the bore 102d of cylinder 102. The interengagement of pegs 101m and grooves 101d prevents radial movement of pins 101b and the concomitant release of the blade of the key within keyway 101a; the blade may only be extracted from keyway 101a when beveled edge 101h of sidebar 101g is correctly aligned with groove 102a. It should be noted that features of mechanical lock and key mechanisms other than those mentioned in U.S. Patent Nos. 3,722,240 and 3,499,303 to Oliver may be used in the practice of the instant invention.

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5. Please amend the paragraph that bridges pages 12 and 13, lines 15 through 12, as follows:
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R5 A release assembly such as a reciprocating solenoid coil 106b driving blocking armature 106a shown in greater detail in Figures 2 and 3, or a rotary motor 108b driving blocking armature; 108a shown in greater detail in Figures 4 and 5A and 5F, or the reciprocating solenoid coil 107b of blocking armature 107a shown in greater detail in Figures 6 and 7, resides within (typically cylindrical) chamber 80. The open distal end of chamber 80 is intersected by a circumferential groove 101 which may partially, or completely, encircle the exterior circumferential surface of plug

R5 101. Coil 106b has a centrally located hole 106f for receiving shaft 106d while detent 106A passes either sidewall 106e of blocking armature 106a. Armature 106a forms the radially outward distal end of solenoid coil 106b, and is radially outwardly biased by spring 106D so as to extend radially upwardly into the path of groove 101ℓ and thereby engage detent 106A. Release assemblies 106, 107, and 108 are electrically connected to an electronic logic and control circuit 104b encapsulated within an electrically insulated casing 104 formed to define an outer sector of cylindrical plug 101. Power, or power, protocol, identification and control data may be transmitted from a key inserted into keyway 101a via electrical conductor 104x, extending between an aperture 101n in the face plate 72 of plug 101 and the electrical conductor (*e.g.*, a local ground return) formed by the electrically conducting parts forming keyway, respectively, and corresponding input ports to circuit 104b. Electrical leads 104m, 104n, extend between a pair of output ports of circuit 104b and either solenoid coil 106c of blocking armature 106a, or solenoid coil 107c of blocking armature 107a, or motor coils 108c of rotary stepping motor 108a.

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6. Please amend the paragraph that bridges pages 13 and 14, lines 13 through 14, as follows:
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R6 The electrical power or alternatively, electrical power, operational protocol, identification and control data passes through aperture 101n via conductor 104x when casing 104 is properly positioned within cavity 101p. Pegs 101s enter corresponding receptacles in casing 104 and position casing 104 relative to plug 101. When casing 104, and its electronic circuit, are seated within plug

cavity 101p, casing 104 is contained within the larger diameter of plug 101, so that the combined plug assembly formed by plug 101 and electronic circuit casing 104 are easily and tightly received within the interior of lock cylinder 102. Blocking armature 106a, 107a or 108a, may be rendered ineffective at limiting or preventing rotation of plug 101 within cylinder 102 and thus considered to be mechanically bypassed until the installation of a cooperating member clip ~~105E~~ 107E or 106E, respectively within slot 102c with the respective detent 106A, 107A disposed within through aperture 102b. A selected one of cooperating member clips ~~105E~~ 107E or 106E installs circumferentially around cylinder 102 and is seated within a conforming circumferential groove 102c when blocking detent ~~105A~~ 107A or 106A is engaged through slot 102b. When installed properly, blocking detent ~~105A~~ 107A or 106A extends through slot 102b and sufficiently into the exposed recess 106c, or slot 107c, 108c in the distal end of the corresponding one of armatures 106a, 107a, 108a, and as plug 101 rotates within cylinder 102, blocking detent ~~105A~~ 107A, 106A travels through groove 101 ~~l~~ around the circumference of plug 101. The shafts 106d, 107d or 108d respectively of blocking armatures 106a, 107a or 108a are made of a magnetically attracted material such as iron or steel. When an unidirectional electrical current is applied through the particular winding 106b, 107b, 108b, the corresponding shaft 106d, 107d, 108d will either axially reciprocate (*i.e.*, radially through its corresponding chamber 82) along axis A or incrementally rotate (*e.g.*, by ninety degrees within its corresponding chamber 82) around axis A and thereby alter the positional relation between blocking detent 106A or 107A relative to the corresponding blocking armature 106a, 107a or 108a.

7. Please amend the paragraph that bridges pages 14 and 15, lines 15 through 17, as follows:

R1  
In the embodiment illustrated by Figures 2 and 3, cooperating member clip 106E and blocking armature 106a are used as a set to form electromechanical release mechanism 106. When clip 106E is inserted into groove 101l with detent 106A protruding through slot 102b, compression spring 106D will hold armature 101a radially outwardly from the coaxial void 106f formed by coil 106b, so that cavity 106c will surround detent 106A. Consequently, sidewalls 106e will stand between detent 106A and circumferential groove ~~102f~~ 101l, thereby blocking rotation of plug 101 within cylinder 102. Assuming that mechanical key cuts (*i.e.*, the "bitting" along the shank of a conventional mechanical key 200) correspond with the coding of mechanical pins 101b, insertion of a key (not shown) into keyway 101a and manual rotation of the key in any direction is blocked by obstruction of detent 106A by stopface 106e; application of power to coil 106b via contact 104x and controller 104, and a responsive reciprocally downward movement of the magnetically attracted blocking armature 106a along axis A toward coil 106b enables the straight edge 106F of blocking detent 106A to clear the upper edge of stopface 106e and to pass freely in that direction within groove 101l. When power is discontinued to coil 106b, spring 106D will then return blocking armature 106a to its extended position, thereby again blocking rotation of plug 101 in any direction due to obstruction of detent 106A by sidewall 106e. If detent 106A is within groove 101l and is not axially aligned with cavity 106c when application of electrical power is withdrawn from coil 106b, continued manual rotation of the key will cause angular edge 107B of detent ~~106A~~ 107A to engage

R7 a slight ~~chamber~~ chamfer on the upper edge of armature ~~106a~~ 107a at ~~106h~~ 107h; camming action of edge ~~106B~~ 107B will force armature ~~106a~~ 107a to axially reciprocate inwardly within its chamber 80 until detent 107A is again engaged by the return outward reciprocating movement of armature 107a under the bias of spring 107D. When detent 106A 107A is coaxially aligned with cavity ~~106c~~ 107c, springs 101k force edge 101h of sidebar 101g radially reciprocate outwardly from grooves 101d and into groove 102a, thereby enabling manual withdrawal of the key from keyway 101a.

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8. Please amend the paragraph that bridges pages 15 through 17, lines 18 through 13, as follows:
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R8 Turning now particularly to Figures 4, 5A, 5B, 5C, 5D, 5E and 5F, when cooperating member clip 106E and blocking armature assembly 106a are used as a set to form release mechanism 108, clip 106E will rest within cavity 108c, defined by two mirror image and spaced apart sidewalls 108e in blocking armature 108a while plug 101 is in the locked position relative to cylinder 102 with edge 101h of sidebar 101g resting within groove 102a. Blocking armature 108a is coaxially mounted upon the shaft of a stepping motor 108A. As represented in Figures 5A, 5B, 5C and 5D, the stepping motor has a single coil 108b; the embodiment shown in Figures 5E and 5F ~~use~~ uses a pair of coaxial coils 108b. The entire motor assembly is encased in a can 108j that is in turn, fitted into cylindrical hole 80. Preferably, stepping motor 108A rotates by ninety degrees in response to application of electrical current to coil, or coils 108b. Referring now to Figure 5A, assuming that upon manual insertion of a key within keyway 101a, mechanical key cuts along the shank of the key correspond

to coding of the row of mechanical pins 101b, rotation of the key in either direction is blocked by engagement of detent 106A with sidewalls 108e of cavity 108c in blocking armature 108a. Turning now to Figure 5B, application of power to solenoid coil 108b and an accompanying rotation of blocking armature 108a around axis A relative to coil 108b in response to flow of the current, enables the straight lowermost edge 106F of blocking detent 106A to pass through gap 108h between opposite sidewalls 108e of cavity 108c and to pass freely into groove 101ℓ, thereby enabling rotation of plug 101 within cylinder 102. When the key is withdrawn from keyway 101a, blocking armature 108a will remain in its current position, thereby blocking rotation of plug 101 in either direction if the current position is as shown in Figure 5A with sidewalls 108e interposed between groove 101ℓ and detent 106A. If however, the current position of blocking armature 108a is as shown in Figure 5B when the key is withdrawn, detent 106A will be able to freely rotate through gaps 108h and into groove 101ℓ when another key with the correct bitting is inserted into keyway 101a. If tab 106A and cavity 108g are significantly misaligned when power is discontinued, then rotation of the plug 101 to the key extraction point where mechanical key retaining pins 101b may disengage from the key blade due to the movement of sidebar 101g into groove 102a, will position small tapered edge 106B to encounter chamber ~~108g~~ 108h. As plug 101 is rotated farther, armature 108a is pushed into the void 108f coaxially defined by coil 107b until tab 106A is again engaged by the return outward movement of armature 108a. NMB Corporation currently manufactures a stepping motor, model number 03BJ-H001-F9 of a type that is sufficiently minaturized to serve in this embodiment. This model uses two separately wound coils 108b. Application of electrical current to the coils incrementally steps the armature 108a to align with the energized ferrous fingers 108n mounted




RS upon the casing and the ferrous fingers 108p mounted upon the ferrous divider 108q. An electrical insulator 108k is mounted on shaft 108d to serve as a divider. Reversal of electrical polarity to the coils will cause a reversal of the direction of rotation of armature 108a. Preferably, each application of power to the coils will initiate a ninety degree rotation so that sidewall 108e will either block passage of detent 106A into groove 101l, or the alignment of slot 108h with detent 106A will accommodate passage of detent 106A into groove 101l and thus enable rotation of plug 101 within cylinder 102.

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9. Please amend paragraph 1 on page 19, lines 4 through 19, as follows:


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R9 Plug 101 also contains sidebar 101g tapered into an acute (frequently blunted), axially extending bearing edge 101h partially recessed into a beveled slot 102a formed axially along the exterior circumferential surface of cylinder 102. Sidebar 101g is typically biased radially outwardly by one or more springs 101k so that the leading axially extending edge 101h of sidebar 101g protrudes into slot 102a of a cylinder 102 encasing plug 101 after the complete plug 101 has been installed into cylinder 102. Pins 101b are cut in this particular embodiment with a groove 101d, which may be made circular to accommodate rotation of pins 101b during insertion of a key. When the blade of a mechanical key that has been bitted to correctly displace pins 101b radially outwardly from keyway 101a within their corresponding chambers 82, is inserted with the cuts of the land of the key precisely matching the coding (axial separation between the upper and lower portions of pins 101b) of pins 101b, then slots 101d will align with the pegs 101m of the sidebar 102g. When

 rotational torque is manually applied to the key by the user, the beveled edges of slot 102a enables sidebar 101g to move radially inwardly toward plug 101 and away from groove 102a against the bias of springs 101k slightly, but enough to allow plug 101 to rotate within cylinder 102, thus concomitantly rotating tailpiece 101q which, in turn, rotates a movable cam 103 or other member engaged by tailpiece 101q.

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10. Please amend the paragraph that bridges pages 22 and 23, lines 14 through 1, as follows:
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 Power may alternately supplied along with data through plug face contacts 104x which is connected to printed circuit 104b. Plug face contact 104x passes through face plate 72 from the cavity 101p to the outside exposed face of the plug via hole 101n. In this version data and optionally power may be supplied by the user held door key. A logic circuit with a microprocessor, communication, memory and switching means will be contained in casing 104 and its circuit 104b. When ~~key means~~ a key is presented and inserted in the lock and contacts on ~~key means~~ the key are in electrical contact with contacts 104, a process of authentication and comparison of encoded data occurs. An agreement of data, will result in the logic circuit switching power to coil 109b. In the event there is not an agreement of data then the lock remains in its normal state.

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11. Please amend paragraph 2 on page 23, lines 9 through 17, as follows:

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R11

One hierarchy for a cylinder lock system is represented in Figure 19, using a standard, mechanically bitted key 210 in conjunction with electromechanical key 200. In this configuration, cylinder locks 211, 212 and 213 are ~~stand-alone~~ stand-alone locks of the type using release assemblies 105, 106, 107 or 108, that can be opened and closed with electromechanical key 200. Cylinder locks 214, 215 are electrically coupled to a host data and power bus and may be opened and closed with either key 200 or with mechanical key 210, albeit the centrally located controller 220 controls, and overrides where desired, access through locks 214, 215 via power and data bus 222. Cylinder locks 106, 107 are stand-alone mechanical locks and may be accessed by either the correct mechanical bitting of electromechanical key 200 or of mechanical key 210.

Figure 20 illustrates a second hierarchy of a cylinder lock system in which electromechanical key 200 providing its own electrical power is able to mechanically and electrically unlock and lock

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